

REMARKS

In the last Office Action, the drawings were objected to under 37 C.F.R. §1.83(a) as failing to show every feature of the invention specified in the claims. Claims 1, 7-9, 120-122, 134 and 136-141 were rejected under 35 U.S.C. §103(a) as being unpatentable over Brezoczky (EPA 0-549-236 A2). Claims 131-133 and 142-143 were objected to as being dependent upon a rejected base claim, but indicated to be allowable if rewritten in independent form including all of the limitations of the base and any intervening claims.

Applicants and applicants' counsel note with appreciation the indication of allowable subject matter concerning claims 131-133 and 142-143. However, for the reasons noted below, applicants respectfully submit that independent claims 1 and 134 and corresponding dependent claims 7-9, 120-122, 134, 136-141 also patentably distinguish from the prior art of record.

Applicants respectfully traverse the objection to the drawings and the Section 103 rejection of claims 1, 7-9, 120-122, 134, 136-141 and request reconsideration thereof in light of the following discussion.

Objection to the Drawings

The drawings were objected to under 37 C.F.R. §1.83(a) as failing to show every feature of the invention specified in the claims. More specifically, the Examiner contends that the drawings do not show the "optical waveguide extending into the inverted conical or pyramidal hole" recited in independent claims 1 and 134. Applicants respectfully disagree with the Examiner's contention.

Figs. 5 and 8 show embodiments of the near-field optical head recited in independent claim 1. Fig. 5 shows the optical waveguide 504 extending into the inverted conical or pyramidal hole 507. Fig. 8 shows the optical waveguide 804 extending into the inverted conical or pyramidal hole 807.

Figs. 21 and 24 show embodiments of the near-field optical head recited in independent claim 134. Fig. 21 shows the optical waveguide 2103 extending into the inverted conical or pyramidal hole (i.e., the hole around the protrusion 2102). Fig. 24 shows the optical waveguide 2403 extending into the inverted conical or pyramidal hole (i.e., the hole around the protrusion 2402).

In view of the foregoing, applicants submit that the drawings clearly show the feature of the invention recited in claims 1 (Figs. 5, 8) and 134 (Figs. 21, 24) relating to the "optical waveguide extending into the inverted conical or pyramidal hole." Accordingly, applicants respectfully submit

that the drawings are in full compliance with 37 C.F.R. §1.83(a) and request that the drawing objection be withdrawn.

Summary of the Invention

The present invention relates to a near-field optical head. With reference to the embodiments shown in Figs. 5 and 11, the near-field optical head 500 comprises a planar substrate 501 having a first surface, a second surface opposite the first surface, and an inverted conical or pyramidal hole 507 having a fine aperture at an apex thereof and extending through the first and second surfaces. As shown in Fig. 11, the inverted conical or pyramidal hole has at least one curved slant surface 1102. An optical waveguide 504 extend into the inverted conical or pyramidal hole 507 of the planar substrate 501 for propagating light along an optical path. A mirror 508 is disposed in the optical waveguide 504 for bending in the direction of the fine aperture the optical path of the light propagated through the optical waveguide 504.

By the foregoing construction of the near-field optical head according to the present invention, a more precise recording on a recording medium can be achieved. This is accomplished by the structure of the near-field optical head which prevents a reduction in strength of near-field light produced from the fine aperture at the apex of the

inverted conical or pyramidal hole, which in turn improves the light propagating efficiency of the near-field optical head and achieves a stronger near-field light.

Traversal of Prior Art Rejection

Applicants respectfully traverse the Section 103(a) rejection and submit that Brezoczky does not render obvious the invention recited in independent claims 1 and 134 and corresponding dependent claims 7-9, 120-122, 134, 136-141.

It is well settled that the Examiner must satisfy his burden of establishing a prima facie case of obviousness by showing that some objective teaching or suggestion in the applied prior art taken as a whole and/or knowledge generally available to one of ordinary skill in the art would have led that person to the claimed invention, including each and every limitation of the claims, without recourse to the teachings in applicants' disclosure. See generally, In re Rouffet, 47 USPQ2d 1453, 1456, 1457-1458 (Fed. Cir. 1998); In re Oeticker, 24 USPQ2d 1443, 1446-47 (Fed. Cir. 1992). In this case, the Examiner has failed to carry his burden of making out a prima facie case of obviousness with respect to the subject matter recited in independent claims 1 and 134 and the corresponding dependent claims, as set forth below.

Brezoczky does not teach a near-field optical head with an inverted conical or pyramidal hole having at least one curved slant surface

Brezoczky discloses an optical head comprising a substrate (i.e., slider) 95 (Fig. 7) having a cone-shaped aperture 92. An optical fiber 97 couples a transmission beam 102 to the slider 95 for further coupling via polarizing means 101 and mirror 103 to an objective lens 93 for focusing at an optical aperture 91. As recognized by the Examiner, the cone-shaped aperture 92 in Brezoczky does not have at least one curved slant surface. Thus, the optical head of Brezoczky suffers from the disadvantages as set forth above for conventional near-field optical heads.

In contrast, independent claim 1 recites a planar substrate having a first surface, a second surface disposed opposite to the first surface, and an inverted conical or pyramidal hole extending through the first and second surfaces, the inverted conical or pyramidal hole having at least one fine aperture formed at an apex thereof and disposed in the first surface and having at least one curved slant surface. Likewise, independent claim 134 requires a substrate having an inverted conical or pyramidal hole penetrating therethrough, the hole being formed by at least one curved slant surface and having at least one fine aperture at an apex thereof.

With respect to the foregoing feature recited in each of independent claims 1 and 134, the Examiner contends that since an "inverted conical or pyramidal hole having at least one curved slant surface" is "old and widely used in the optical recording art", the selection of such structure for the near-field optical head of Brezoczky is deemed obvious. Applicants respectfully disagree with the Examiner's contention and conclusion of obviousness to arrive at the claimed invention.

The Examiner has failed to establish a recognition in the prior art, and thus knowledge thereof, of a near-field optical head with an inverted conical or pyramidal hole having at least one curved slant surface, as required by independent claims 1 and 134. While recognizing that it is known to provide an inverted cone-shaped hole with slant surfaces having different degrees of slant, applicants respectfully submit that this knowledge does not render obvious the provision of an inverted conical or pyramidal hole with at least one curved slant surface, as recited in independent claims 1 and 134. There is nothing in Brezoczky that would suggest providing the cone-shaped aperture or hole 35 with at least one curved slant surface.

Furthermore, there is no recognition in Brezoczky of the advantages achieved by providing a near-field optical head with an inverted conical or pyramidal hole having at least one

curved slant surface, as required by independent claims 1 and 134. More specifically, the provision of the inverted conical or pyramidal hole of the near-field optical head with a curved slant surface prevents the reduction in strength of near-field light produced from the fine aperture at the apex of the inverted conical or pyramidal hole. Accordingly, the light propagating efficiency of the near-field optical head is improved and a stronger near-field light is achieved, thereby resulting in more precise recording on a recording medium.

Brezoczky does not teach a near-field optical head having an optical waveguide extending into an inverted conical or pyramidal hole of a planar substrate

Each of independent claims 1 and 134 requires an optical waveguide extending into the inverted conical or pyramidal hole of the planar substrate for propagating light along an optical path. The Examiner recognized that this structural feature is not disclosed by Brezoczky. The Examiner contends, however, that it would have been obvious to one of ordinary skill in the art at the time the invention was made to achieve the foregoing structural feature because the optical fiber 97 in Brezoczky "is flexible and extendable into any directions and/or places" and "could be made to extend into an inverted conical or pyramidal hole as claimed." Applicants respectfully disagree with the Examiner's contention and conclusion of obviousness to arrive at the claimed invention.

Applicants respectfully submit that the proposed modification of the optical head in Brezoczky (i.e., extending the optical fiber 97 into the cone-shaped aperture 92) is improper because the prior art teaches away from the claimed combination. A reference teaches away when a person of ordinary skill in the art, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that the applicant took. In re Gurley, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994). Stated otherwise, a reference teaches away if it suggests that the line of development falling from the reference's disclosure is unlikely to be productive of the result sought by applicants. W.L. Gore & Assocs. v. Garlock, Inc., 220 USPQ 303, 311 (Fed. Cir. 1983) (the totality of a reference's teachings must be considered), cert. denied, 469 U.S. 851 (1984); In re Caldwell, 138, USPQ 243, 245 (CCPA 1969) (reference teaches away if it leaves the impression that the product would not have the properties sought by the applicant).

In this case, the prior art teaches away from the claimed combination because in Brezoczky the optical fiber 97 is straight and not bent (see Fig. 6), and cannot be extended into the cone-shaped aperture 92 due to the fact that the light from the optical fiber 97 needs to be guided to the cone-shaped aperture 92 via polarizing means 101, mirror 103,

and objective lens 93, which are located generally between the optical fiber 97 and the cone-shaped aperture 92. Furthermore, even if the optical fiber 97 could be bent, such as by force, as proposed by the Examiner, light would likely leak from the bending point of the optical fiber, which would render the optical head of Brezoczky inoperable.

Thus, contrary to the Examiner's contention, one of ordinary skill in the art at the time the invention was made would not have been led to modify the optical head of Brezoczky so as to extend the optical fiber 97 into the cone-shaped structure 92 because such modification would be contrary to the teachings of Brezoczky and would further render the optical head of Brezoczky inoperable as set forth above. Accordingly, independent claims 1 and 134 are not rendered obvious by the teachings of Brezoczky because the reference does not suggest the modifications that would be needed to replicate the claimed invention. In the context of obviousness rejections based upon the purported obviousness of effecting a required modification, the Federal Circuit has held that "[t]he mere fact that the prior art may be modified in [a given] manner ... does not make the modification obvious unless the prior art suggested the desirability of the modification". In re Fritch, 23 USPQ2d 1780, 1783 (Fed. Cir. 1992). There is nothing in Brezoczky that would have suggested modifying the structure of its optical head to

achieve the structure of the near-field optical head discussed above and recited by independent claims 1 and 134.

Moreover, there is no recognition in Brezoczky of the advantages achieved by providing a near-field optical head with an optical waveguide that extends into an inverted conical or pyramidal hole of a planar substrate, as recited in independent claims 1 and 134. More specifically, the provision of an optical waveguide that extends into the inverted conical or pyramidal hole of the planar substrate increases the overall propagation efficiency and strength of the near-field light because the optical waveguide is able to propagate light that is guided in a parallel direction relative to a planar surface of a recording medium up to the vicinity of the fine aperture of the inverted conical or pyramidal hole. As a result, additional focusing elements (i.e., such as the polarizing means 102, mirror 103, and objective lens 93 of Brezoczky) are not required, thereby facilitating a reduction in the overall size of the near-field optical head. Furthermore, a spot diameter of the near-field light becomes smaller and the optical strength of the near field light is increased because the near-field optical head achieves a shorter floating distance from the recording medium. Accordingly, a higher recording density is achieved as compared to the conventional art.

Moreover, the foregoing advantages achieved by the structure of the near-field optical head of the invention embodied in independent claims 1 and 134 is in contrast to conventional near-field optical heads, such as the optical head of Brezoczky) which do not provide an optical waveguide that extends into an inverted conical or pyramidal hole of a planar substrate and a conical or pyramidal hole with a plurality of non-curved slant surfaces which suffer from flashing of propagating light at apexes between the non-curved slant surfaces that causes a decline of the near-field light produced at the fine aperture of the inverted conical or pyramidal hole. Moreover, leaking of the propagating light at the apexes results in recording on a part of a recording medium that is not intended to be recorded. As a result, the light propagating efficiency of the near-field optical head is poor and recording cannot be carried out with precision.

Claims 7-9, 120-122 and 136-141 depend on and contain all of the limitations of independent claims 1 and 134, respectively, and, therefore, distinguish from Brezoczky at least in the same manner as set forth above for independent claims 1 and 134.

In view of the foregoing, applicants respectfully request that the rejections of claims 1, 7-9, 120-122, 134 and 136-141 under 35 U.S.C. §103(a) as being unpatentable over Brezoczky be withdrawn.

In view the foregoing, favorable reconsideration and passage of the application to issue are most respectfully requested. In the event the Examiner determines that something further need be done to place the application in allowable form, it is respectfully requested that the Examiner telephone the undersigned attorney at the below-listed number whereupon any outstanding matter will be promptly attended to.

Respectfully submitted,

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